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ABQ02

CALCULATION COVER SHEET

Project:	**INEEL V-Tank Remediation Project**				**Number of Sheets:** 1 of 111
Site:	Test Area North, Idaho Falls, Idaho				
Calculation Number:	ABQ02 – HP002		**Work Order Number:**	12393.002.001	
Subject:	**Configuration of V-Tank Wastes for DOT Packaging /Transportation and Determination of Classification with Respect to 10 CFR §61.55**				
Rev #	**Date:**	**Revision:**	**Calculated by:**	**Checked by:**	**Approved:**
RAA		60%	Gordon Harris	Berg Keshian	Berg Keshian
RAB	5/30/01	90%	Gordon Harris	Berg Keshian	Berg Keshian
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RAD	9/27/01	Draft Final	Gordon Harris	B. Keshian	9-28-01

Problem Statement:

Utilizing provided characterization data and volume estimates from references above determine the optimum packaging configuration for the V-Tank wastes ensuring compliance with applicable Department of Transportation (DOT) regulations, requirements and specifications. Packaging configuration of the wastes will also take into consideration the classification of the waste as either Class A or Class B with respect to the regulations specified at 10 CFR §61.55. The ultimate packaging configuration will also have to be compliant with the applicable TSD Facility WAC and Radioactive Material License.

Method of Solution:

Input data, specifications, and applicable regulatory criteria into Excel 97 spreadsheets that have been designed and validated to determine appropriate DOT shipping criteria and 10 CFR §61.55 classification. Note that these spreadsheets are attached as referenced herein.

Note: The DOT spreadsheet contains formulas that have been validated or "check printed" to ensure cells are referenced correctly and arithmetic operations and algebraic calculations are correct. The spreadsheet is then "locked" using the password protection function. The values and subsequent determinations that the algebraic formulas calculate have been independently verified using RADCALC software available through the DOE/NTP website. Calculations are also independently verified using a Hewlett-Packard model 48G+ hand held calculator.

Three options were developed for containerizing the V-Tank wastes for compliance: 1) applicable DOT packaging requirements; 2) meet the defining criteria of a Class A or Class B waste as specified in 10 CFR §61.55; and, 3) TSD facility specific WAC with respect to acceptable volumes for processing.

- Option 1 looked at first mixing the entire contents of each V-Tank to ensure a homogenized waste steam. Then, the appropriate volume from each tank would be placed into a HIC mixing it with the appropriate volume of clean soil so that the resultant total volume met the criteria of a Class A waste. This option does not take into consideration TSD facility WAC but was developed to demonstrate creative problem solving and to get a characterization picture of the entire contents of each V-tank.
- Option 2 looked at containerizing the homogenized waste into the minimum number of HICs to be compliant with the Type B shipping container's Certificate of Compliance with respect to allowable quantity of fissile material and irrespective of whether the material was a Class A or whether it met WAC. This option was developed to give management personnel characterization information that would be necessary if temporary storage onsite or offsite was to be considered.
- Option 3 looked at separating the phases of each tank and containerizing the liquid and sludge or solid portions. Each phase would then be evaluated to determine the appropriate volume necessary to place into a DOT specification 55-gallon drums and thereby demonstrate compliance with DOT and Type B shipping cask packaging requirements and the Class A criteria per 10 CFR §61.55, and TSD facility specific WAC.

Assumptions:

1. The sludge content of each V-Tank will be mixed thoroughly to ensure a homogeneous material and that to the extent practicable; the radioactivity will be essentially uniformly distributed throughout the mixture.
2. High Integrity Containers (HIC) PL8-120MT may be used as the primary containment for liquid waste shipments, as required.
3. Sludge will be placed in PL8-120 FP/FEDX HICs
4. Due to the HIC's maximum net weight capacity of 6900 pounds and net volume capacity of 804.9 gallons, each HIC can only be filled to approximately 78% capacity using a typical soil density of 1.28 g/cc.
5. The mixture of clean soil in Option 1 (i.e., soil whose radioactivity does not contribute appreciably to the radioactivity of the waste in a HIC) is permissible to meet 10 CFR §61.55 criteria as a Class A radioactive waste. This option was rejected due to WAC disposal and manifesting requirements.

(Note: refer to "Issuance of Final Branch Technical Position on Concentration Averaging & Encapsulation," revision in part to waste classification technical position, January 17, 1995.)

6. The DOT spreadsheets compare the activities for each packaging configuration of V-Tank wastes to DOT Transportation Types. Waste stream analysis will need to be reviewed by the appropriate disposal facility prior to final packaging and shipping.
7. This evaluation does not evaluate V-Tank wastes for compliance with any waste disposal facility or the acceptance criteria with respect to RCRA/TSCA constituents.
8. The numbers derived by the DOT spreadsheets should be used as estimates only. The determinations made by interpretation of the data in the DOT spreadsheets should be carefully considered with respect to the quality of the radiological characterization data provided.
9. With regards to the characterization data, when a radionuclide was not detected, its detection limit was used as a conservative estimate. Note that this conservative assumption has essentially no effect on the overall determinations.
10. Th-234 and Pa-233 are assumed to be in secular equilibrium with the parent radionuclides, U-238 and Np-237 respectively; their activities have been added as appropriate.
11. The activity of Pu-241 has been added at 9.52 times the activity of Am-241 per 49 CFR §173.433 requirements.

Sources of Formulas and References:

Characterization Data from:

Comprehensive Remedial Investigation/Feasibility Study (RI/FS) *for Test Area North Operable Unit 1-10 at INEEL,* DOE/ID-10557, November 1997, Dept. of Energy/Idaho Area Office, Idaho Falls, ID.

V-Tank Waste Volumes from:

Memorandum from Carolyn S. Blackmore to J. Todd Taylor, 03/10/98, *Criticality Safety Issues Associated With The Test Area North V-Tanks* – CSB-004-98, Lockheed Martin Idaho Technologies Company.

Specifications for Duratek Type B shipping cask and HICs from:

Duratek Transport Cask Inventory, "CNS 8-120B"

Docket No. 71-9168, Model No. CNS 8-120B Package, Certificate of Compliance for Radioactive Material Packages, Certificate Number 9168, Revision 11, U.S. Nuclear Regulatory commission

Duratek Polyethylene HICs Dimensions and Volumes, "PL`8-120MT"

E-mail from Phil Strahm to Ken Schaus, July 2, 2001, Type B Cask Requirements

Regulatory Requirements from:

49 CFR 171-178, October 2000, "Transportation", Parts 171 through 178, "General Information, Regulation, and Definitions, Hazardous Materials Tables, an Shipping and Packaging Requirements", *Code of Federal Regulations*, Office of the Federal Register.

10 CFR 61, October 2000, "Energy", Part 61, "Licensing Requirements for land Disposal of Radioactive Waste", *Code of Federal Regulations*, Office of the Federal Register.

Issuance of Final Branch technical Position of Concentration Averaging & Encapsulation, revision in part to waste classification technical position, January 17, 1995, Nuclear Regulatory Agency, Washington, D.C.

Calculation:

The activity data contained in Sample Profile Data For Maximum and Average DOT and 10CFR 61.55 Calc were used (attachment 2) as the basis for all the DOT and burial determinations. This data was taken from sample information provided in the characterization data provided in *Comprehensive Remedial Investigation/Feasibility Study* (RI/FS) *for Test Area North Operable Unit 1-10 at INEEL* (DOE/ID-10557, November 1997). The characterization data was converted from picocuries per gram (pCi/g) or picocuries per liter (pCi/L) to curies (Ci). Average and maximum data values were then calculated for each radionuclide listed on the Profile Data Tables for each liquid sludge phase contained in Tank V-1, V-2, V-3 and V-9. Note that an average and maximum data value was not calculated for each tanks liquid phase since only one sample result was reported. The sludge density (estimated at 1.02 g/cc) was converted from the appropriate V-Tank analytical data to g/cc.

The data was then copied into the appropriate DOT spreadsheet (with respect to a particular packaging configuration) manipulating the percent of total activity before copying. For example, if a particular tank's waste content were to be divided into 10 HICs, then the total average and/or total maximum activity would correspondingly be divided by 10. The amount of waste and percent activity is dependent upon the packaging configuration with respect to meeting Class A criteria (Option 1) or ensuring 15 grams or less of fissile material per package (Options 2 and 3). The results of the DOT spreadsheet calculations are provided below.

Discussion:

Radiological characterization data and waste volumes were input into DOT spreadsheets to analyze the three packaging configurations as specified in Options 1, 2, and 3. The results are reported below as follows:

Table 1. Results of Configuring V-Tank Water and Liquid Sludge adding Soil to HICs by Option1.

Tank Number:	V-1	V-2	V-3	V-9
Amount of Liquid Sludge/Tank (gal.)	1684	1596	6470* (8300)	320
No. contaminated gallons/HIC	7.5	4	8.5	3.5
No. gallons "clean" soil/HIC	511	514	511	514
No. of HICs for Disposal	225	399	762	92
Total amount of soil needed/Tank (gal.)	116,420.5	206,682.0	395,431.0	47,314.0
Total amount of soil needed/Tank (yd^3)	576.4	1023.3	1957.8	234.3
Total Avg. Activity/HIC(Ci)	1.694E-01	1.158E-01	1.019E-01	1.396E-01
Total Avg. Sr-90/HIC (Ci)	6.897E-02	6.899E-02	7.191E-02	6.835E-02
Total Avg. Cs-137/HIC (Ci)	7.880E-02	3.909E-02	2.527E-02	5.902E-02
Total Avg.Co-60 (Ci)	2.175E-03	1.352E-03	6.20E-04	9.956E-03
Classification of drums (10CFR 61.55)	Class A	Class A	Class A	Class B

*The gallons of liquid indicated in tank V-3 was the quantity at the time of sample. This number represents a more conservative concentration than if the current 8,300 gallons were used.

Refer to Table 1.The total number of HICs to dispose of all V-Tank wastes using option 1 is 1,478. The total amount of "clean" soil needed (which is not permissible per "Issuance of Final Branch Technical Position on Concentration Averaging & Encapsulation," revision in part to waste classification technical position, January 17, 1995.) is approx. 7.66E+05 gallons (3,793 yd^3). The figures presented in Table 1 do not take into account the volumes or activities of the wastes to be flushed from ancillary piping and/or rinsates. Attachment 3 contains the DOT and 10 CFR §61.55 near surface burial criteria spreadsheets used to derive the results cited in Table 1. This process would require diluting the activity using soil from around the tanks. Based on the activity contained in each tank the amount of soil placed in each HIC would be prohibitive as well as illegal. This information is provided to demonstrate how concentrated the activity is inside these tanks and how much aggregate would be required to ship in HICs to meet the burial criteria of Class A waste.

Table 2. Results of Configuring V-Tank Waste at ≤ 15 g Fissile in each HIC by Option 2.

Tank Number:	V-1	V-2	V-3	V-9
Amount of Waste/Tank (gal.)	1684	1596	6470* (8300)	320
Amount of Fissile Material/Tank Grams	148	94.2	88.3	156
No. of HICs @ 15 g or less Fissile Material	10	7	6 (9)	11
Amount of Liquid Sludge/HIC (gal)	168.4	228	*719	29.1
Total Avg. Activity/HIC(Ci)	16.25	6.58	8.25	11.6
Total Avg. Sr-90/HIC (Ci)	6.67	3.909	5.82	5.86
Total Avg. Cs-137/HIC (Ci)	7.62	2.215	2.048	4.9
Total Avg.Co-60 (Ci)	.214	7.662E-02	5.029E-02	8.274E-01
Classification of drums (10CFR 61.55)	Class B	Class B	Class B	Class B

* The gallons of liquid indicated in tank V-3 was the quantity at the time of sample. This number represents a more conservative concentration than if the current 8,300 gallons were used. The number 719 was based on this conservative concentration.

Refer to Table 2. The total number of HICs to be placed in interim storage. The HICs contain all the V-Tank wastes (without respect to meeting the definition of being a Class A waste) but being compliant with the fissile material restrictions of the Type B DOT shipping cask. The number of HICs needed was determined to be 34, however, due to the weight restrictions of the HIC, the V-3 Tank wastes would need to be packaged into 9 HICs resulting in 37 HICs total. Table 2 above provides information on gross storage activity of sludge and water in HICs. This option would create large quantities of liquid sludge in HICs. Although the HICs meet the shipping criteria for a fissile activity no considerations were given to the total activity, the liquid content in the HICs, or the restriction/limitation imposed on the facility required to process the liquid sludge. This option would require the liquid sludge to be repackage and stabilized for proper Class B mix waste burial requirements. Attachment 3 contains the DOT and 10 CFR 61.55 Near Surface Burial Criteria spreadsheets used to derive the results cited in Table 2.

Table 3a. Results of Configuring V-Tank Sludge Phase Wastes by Option 3 Using Average Data Values.

Tank Number	V-1	V-2	V-3	V-9
Total Activity/Tank (Ci)	37.9	45.7	77.0	12.6
Amount of Fissile Material/Drum (g)	14.7	9.12	6.4	14.1
Amount of sludge/drum (gal.)	52	52	50.2	22.73
No. of drums	10	10	13	11
Total Activity/drum (Ci)	3.79	4.57	5.92	1.15
Total Sr-90/drum (Ci)	1.55	2.75	4.19	0.562
Total Cs-137/drum (Ci)	1.77	1.55	1.47	0.490
Classification of drums (10CFR 61.55)	Class B	Class B	Class B	Class B

Refer to Table 3a. Using average sample data values, the V-Tank sludges would all be Class B wastes, which would require a prospective TSD Facility to have the appropriate radioactive material licensing. It should be noted that the amount of waste per container is being driven by the DOT fissile material per package limit of 15 grams or less and not the Sr-90 and Cs-137 Curie content per package. Also, note that for Tank V-9 wastes the amount of Sr-90 and Cs-137 is relatively low due to the reduced volume of waste per container (22.73 gallons for this example). The reduced volume of V-9 Tank waste at 22.73 gallons per drum has a corresponding 14.1 grams of fissile material (mostly U-235) which is below the DOT fissile material limit per package. To fill the 55-gallon drum to capacity with V-9 Tank wastes would exceed the per package fissile material limit. Attachments 4, 5, 6, and 7 under the spread sheet data title, Tank V-1,V-2,V-3 and V-9 respectively, Container ID # gal/drum w/AVG provide the activity data to support both the DOT and Burial Classification of waste.

Table 3b. Results of Configuring V-Tank Sludge Phase Wastes by Option 3 Using Maximum Data Values.

Tank Number	V-1	V-2	V-3	V-9
Total Activity/Tank (Ci)	69.3	66.9	141.0	14.2
Amount of Fissile Material/Drum (g)	14.5	10.4	11.4	14.1
Amount of sludge/drum (gal.)	26	52	50.2	17.85
No. of drums	20	10	13	14
Total Activity/drum (Ci)	3.47	6.69	10.8	1.02
Total Sr-90/drum (Ci)	1.44	3.31	8.61	0.487
Total Cs-137/drum (Ci)	1.59	2.83	1.75	0.439
Classification of drums (10CFR 61.55)	Class B	Class B	Class B	Class B

Refer to Table 3b. Using maximum sample data values the V-Tank sludges would all be Class B wastes, which would require a prospective TSD Facility to have the appropriate radioactive material licensing. For instance, the amount of Sr-90 per drum of V-3 Tank waste is 8.61 Ci, which exceeds the ATG Radioactive Material License limit of 4 Ci. However, the quantities of waste per container are compliant

with DOT packaging requirements with respect to amount of fissile materials (i.e., less than or equal to 15 grams). Note that for Tank V-9 wastes the amount of Sr-90 and Cs-137 is relatively low due to the reduced volume of waste per container (18 gallons for this example). The reduced volume of V-9 Tank waste at 18 gallons per drum has a corresponding 14.1 grams of fissile material (mostly U-235) which is below the DOT fissile material limit per package. To fill a 55-gallon drum capacity with V-9 Tank waste would exceed the per package fissile material limits. Attachments 4, 5, 6, and 7 under the spread sheet data title, Tank V-1, V-2, V-3, and V-9 respectively, Container ID # V-1, V-2, V-3 and V-9 Solids (# gal per drum using MAX) provides the activity data to support both the DOT and Burial Classification of waste.

Table 3c. Results of Configuring V-Tank Sludge Phase Wastes by Option 3 Using Maximum Data Values and Limiting Quantities to meet ≤ 4 Curies Sr-90 and Fissile Material Requirements.

Tank Number	V-1	V-2	V-3	V-9
Total Activity/Tank (Ci)	69.3	66.9	141.0	14.2
Amount of Fissile Material/Drum (g)	14.5	10.2	5.45	14.1
Amount of sludge/drum (gal.)	26	52	24	18
No. of drums	20	10	27	14
Total Activity/drum (Ci)	3.47	6.69	9.02	1.02
Total Sr-90/drum (Ci)	1.44	3.31	3.94	0.487
Total Cs-137/drum (Ci)	1.59	2.83	.802	0.439
Classification of drums (10CFR 61.55)	Class B	Class B	Class B	Class B

Refer to Table 3c. Using maximum sample data values the V-Tank sludges would all be Class B wastes, which would require a prospective TSD Facility to have the appropriate radioactive material licensing. By reducing the amount of liquid sludge by approximately 50% in Tank V-3 you would be able to meet both the amount of Sr-90 per drum for all the tanks and not exceed the proposed ATG Radioactive Material License limit of 4 Ci/container. This option enables both the quantities of waste per container to meet DOT packaging requirements with respect to amount of fissile materials (i.e., less than or equal to 15 grams) and disposal facility limitations. Note that for Tank V-9 wastes the amount of Sr-90 and Cs-137 is relatively low due to the reduced volume of waste per container (17.85 gallons for this example). The reduced volume of V-9 Tank waste at 17.85 gallons per drum has a corresponding 14.1 grams of fissile material (mostly U-235) which is below the DOT fissile material limit per package. To fill a 55-gallon drum capacity with V-9 Tank waste would exceed the per package fissile material limits. Attachments 4, 5, 6, and 7 under the spread sheet data title, Tank V-1, V-2, V-3, and V-9 respectively, Container ID # V-1, V-2, V-3 and V-9 Solids (# gal per drum using MAX) was used to provide data for this table. Amounts indicated in Table 3c for Tank V-3 are approximately 50% of the amount specified in the attachments. Each of these sheets provide the activity data to support both the DOT and Burial Classification of waste based on limiting the amount of fissile material in each drum.

Table 4 Results of Configuring V-Tank Liquid Phase Wastes per Option 3 into HICs.

Tank Number	V-1	V-2	V-3	V-9
Total Activity/Tank	0.157	0.493	0.505	0.160
Amount of liquid/HIC (gal.)	582	538	725	35
No. of HICs	2	2	8	*2
Total activity/HIC (Ci)	0.0787	0.247	0.0629	0.0801
Total Activity Sr-90 (Ci)	0.00447	0.00998	0.0338	0.0331
Total Activity Cs-137 (Ci)	0.00639	0.0275	0.0116	0.0000556
Classification/HIC	Class A	Class A	Class A	Class B

Refer to Table 4 and Attachment 8. Average and maximum sample data values were not used because only one sample data set was reported for the V-Tank liquids. The V-1, V-2, and V-3 liquid tank wastes would be Class A wastes if no attempt to treat water to a lower activity was made. The quantities of waste per container are compliant to packaging requirements with respect to amount of fissile materials (i.e., less than or equal to 15 grams). If verification sampling of the V-Tank sludge wastes closely approximates the concentrations indicated by the existing characterization data, then it would be reasonable to expect that these liquid wastes could be containerized into approximately (12) HICs. Each of the HICs could be shipped to a prospective TSD facility (e.g., solidification and shipping to Envirocare) as DOT Class 7 LSA-II liquids using excepted packaging (i.e., overpacking in Type B cask unnecessary). Attachment 4,5, 6 and 7 under the spread sheet data title, Tank V-1,V-2,V-3 and V-9 respectively, Container ID # V-1, V-2, V-3 and V-9 Solids (Liquids Total) was used to provide data for this table. Each of these spread sheets provide the activity data to support both the DOT and Burial Classification of waste based on limiting the amount of fissile material in each drum.

The V-9 liquid tank wastes were determined to be Class B wastes. The concentration of H-3 may be a contributing factor to this waste not meeting Class A criteria. It should also be noted that the V-9 liquid tank waste would be containerized into 55-gallon drums due to the low volume.

Summary of Results:

Three options or packaging configurations were developed and evaluated for containerizing the V-Tank wastes.

The first option provided a method of mixing soil in concentration that reduce activity level to within Class A burial requirements. This process is not practical and is not permitted based on the NRC position paper, *Issuance of Final Branch technical Position of Concentration Averaging & Encapsulation*, revision in part to waste classification technical position, January 17, 1995, Nuclear Regulatory Agency, Washington, D.C.

The second option containerized in quantities that met the DOT requirements for fissile material but would exceed the burial requirements for Class A mixed waste. It is expected that Class B mix waste will be accepted by the proposed treatment, storage, and disposal (TSD) facility by the end of 2001 but the activity per container would be far below the level contained in each HIC. Specifically, ATG – Richland's waste acceptance criteria (WAC) and radioactive material license would require that containerized waste for vitrification not exceed 4 curies of activity for Sr-90.

Option 1 looked at configuring the homogenized wastes from each tank into high integrity container (HIC)s mixing with clean soil to meet the criteria of a Class A waste. Although Option 1 was initially known to not be very practicable, it demonstrated some creative problem solving and allowed personnel

to get a characterization picture of the total waste volume in each V-tank. This information was used in developing subsequent packaging configurations.

Option 2 looked at containerizing the homogenized waste into the minimum number of HICs to be compliant with the Type B shipping container's Certificate of Compliance with respect to allowable quantity of fissile material and irrespective of whether the waste was a Class A or Class B waste. This option was developed to allow personnel to make an informed decision if it would be necessary to temporarily store waste onsite and/or transporting the waste to an alternate temporary storage location before ultimate treatment and disposal.

Option 3 looked at separating the phases of each tank and containerizing the solid or sludge portion into DOT specification 55-gallon drums. The resultant liquid sludge phase volumes could be made compliant with respect to DOT fissile material quantity limits for Type B shipping cask by limiting the amount of liquid sludge placed in each drum. This option would still classify the waste under 10 CFR 61.55 as Class B. The liquid fraction of each V-Tank would be treated to meet LDR requirements, pumped into strong tight containers, and then solidified to meet the specific requirements of the applicable WAC.

Conclusions and Recommendations:

1. It was determined that option 1 was cost prohibitive due to the large number of HICs and associated transportation costs. Also, Option 1 is not allowed per "Issuance of Final Branch Technical Position on Concentration Averaging & Encapsulation," revision in part to waste classification technical position, January 17, 1995.

2. Option 2 would only be a temporary solution allowing time for potential regulatory roadblocks to be reconciled and would likely require further repackaging of contents at some future date. The Duratek CNS 8-120B Type B cask is only rated for 15 gram or less of fissile material per it's Certificate of Compliance. If only V-1 Tank wastes were placed into (1) HIC at 725 gallons, it would contain approximately 63.8 grams of fissile material. Therefore, configuring the homogenous V-Tank wastes into HICs per Option 2 is considered impracticable. This option would be feasible only for temporary storage of wastes pending ultimate disposition.

3. Packaging the V-Tank wastes in accordance with Option 3 may be considered the best solution at this time. The V-1, V-2, V-3, and V-9 liquid tank wastes may be considered for acceptance at the appropriate TSD facility with respect to meeting radioactive and 10 CFR §61.55 classifications. This would assume that these liquid wastes would meet RCRA/TSCA waste acceptance criteria after treatment to meet LDR restrictions. The liquid tank wastes would be packaged into DOT specification containers and shipped as DOT Class 7 LSA-II materials or Type A waste after solidification and treatment depending on the levels achieved from treatment.

   The V-Tank sludge or solid phase wastes may require interim storage onsite and dewatering with subsequent sampling to determine the optimum disposal pathway. Ultimate disposal of the V-Tank sludge phase waste will very likely require a radioactive material licensing variance. However, the V-Tank sludge phase waste as configured in 55-gallon drums in Option 3 would be DOT compliant. This packaging option assumes that the liquid sludge would be dewatered to <1% free liquid by volume (e.g., filtration, expression, centrifugation, or clarification), thereby being compliant with the industry practice of the Type B shipping cask's COC. Dewatering drums have been designed to ensure that water content of drums meets the requirements for shipping in a Duratek CNS-8-120B cask following a period of interim storage.

4. Expected dose rates from the V-Tank contents indicate that there should not be any problems expected with complying with the DOT Type B shipping cask dose rate requirements for packaging and shipping. Particularly the liquid portions of tanks V-1, V-2, and V-3 that may be determined to be shipped as LSA-II Class 7 radioactive materials. The sludge wastes packaged into 55-gallon de-watered drums should easily comply with activity and dose rates for Type B shipping casks based on estimated dose calculated in design Calculation ABQ01-HP001.

5. Untreated V-Tank liquids would need to be solidified and disposed of as a Class A waste and shipped as LSA-II packages. V-9 liquids would need to be treated as Class B waste and shipped in a Type A container.

6. Attachment 9 summarizes the data for the sand filter. Based on the limited data available for the sand filter, the material is classified as a Class B waste. For shipping the waste can be packaged in 55-gal drums and shipped as LSA-II materials.

7. Attachment 10 is an excerpt from 10 CFR 61 which states that prior to disposal of liquids, they must be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid. This will apply to all V-Tank liquids prior to disposal.

8. Attachment 11 is an e-mail from Phil Strahm at Duratek, Inc., on dewatering requirements for Type B casks and is the justification for the 1% free liquid used to determine dewatering of the sludge.

List of Attachments

Attachment	Title
1	Duratek Transport Cask Inventory
2	Table 3. Duratek Polyethylene HICs Dimensions and Volumes
	Certificate of Compliance No. 9168, Rev. 11, Docket No. 71-9168
	Certificate of Compliance High Integrity Containers DHEC-HIC-PL-001
2	(Excel 97 Spreadsheets used to convert INEEL Data)
	Data Sheets
	"V-1 Tank Avg_Max_Total Calcs"
	"V-2 Tank Avg_Max_Total Calcs"
	"V-3 Tank Avg_Max_Total Calcs"
	"V-9 Tank Avg_Max_Total Calcs"
3	(DOT (Excel 97) Spreadsheets used to calculate data for Options 1 & 2)
4	(DOT Spreadsheets for Tank V-1 used to calculate data for Option 3.)
5	(DOT Spreadsheets for Tank V-2 used to calculate data for Option 3.)
6	(DOT Spreadsheets for Tank V-3 used to calculate data for Option 3.)
7	(DOT Spreadsheets for Tank V-9 used to calculate data for Option 3.)
8	New Calc for all V-Tank Liquids
9	Sand Filter Analysis
10	10 CFR 61 Land Disposal of Radioactive Waste
11	E-mail from Phil Strahm at Duratek, Inc.

ATTACHMENT 1

Duratek Transport Cask Inventory
Table 3. Duratek Polyethylene HICs Dimensions and Volumes
Certificate of Compliance No. 9168, Rev.11, Docket No. 71-9168
Certificate of Compliance High Integrity Containers DHEC-HIC-PL-001

Duratek

Duratek Transport Cask Inventory

CNS Transport Container	No.	Classification C of C	Internal Dim. Dia. X Hgt.	PB Shielding Equivalence (inches)	Approx. Maximum Rad-levels (R/hr) based on 10% Cobalt 60	Liner Capacity (ft^3)	Drum (55-gal) Capacity	Approx. Maximum Empty Weight (lbs.)	No Limit Maximum Payload (lbs.)
CNS 1-8	1	Type B USA/9070/B	24.00" x 34.50"	Nil	0.200	9	1	200	550
CNS 1-13G	1	Type B USA/9216/B	26.50" x 54.00"	6.20	6,000	17	1	25,500	No Limit
CNS 1-13C	1	Type B USA/9081/B	26.50" x 54.00"	5.70	4,500	17	1	20,950	5,000
CNS 3-55	2	Type B USA/5805/B	36.00" x 116.75"	7.00	15,000	60	3	64,980	9,220
CNS 4-85	1	Type B USA/6244/B	46.00" x 100.00"	3.38	35	88	4	40,300	5,700
CNS 6-75	1	DOT 7A	53.00" x 74.50"	4.00	235	85	6	31,000	10,300
CNS 6-80-2	5	DOT 7A	59.00" x 58.00"	5.00	1,860	91	4	44,000	7,500
CNS 8-120A	4	DOT 7A	62.00" x 75.00"	4.50	880	130	8	49,300	20,000
CNS 8-120B	4	Type B USA/9168/B	62.00" x 75.00"	4.50	880	130	8	49,300	14,680
CNS 10-160B	1	Type B USA/9204/B (U)-85	68" X 77" (w/o SS liner) 57 ¾" x 76 ¾" (with SS liner)	3.13	78	161	10	47,000	14,500
CNS 14-170 Series II	4	DOT 7A	75.50" x 73.25"	2.13	15	185	14	33,800	14,000
CNS 14-170 Series III	5	DOT 7A	75.50" x 73.25"	2.13	15	185	14	35,200	17,800
CNS 14-190H	1	DOT 7A	75.25" x 73.38"	3.50	50	185	14	45,200	20,000
CNS 14-195H	9	DOT 7A	77.00" x 80.13"	2.63	21	215	14	39,650	17,700
CNS 14-215H	8	DOT 7A	77.00" x 80.25"	2.73	20	215	14	38,400	18,800
CNS 15-160	1	Strong, Tight Container	126" x 36" x 75"	1.50	1.9	2 @ 80	15	37,000	No Limit
CNS 18-450	1	Strong, Tight Container	86.00" x 86.00" x 100.00"	1.50	No more than 1 R/hr on Contact	450	18	37,000	No Limit
CNS 21-300	10	DOT 7A	83.00" x 109.25"	1.50	3	340	21	30,200	27,250
21-300 w/ shield insert	2		76" x 106 ½"	2.00	3.00	170	8	39,310	27,250
FSV-1	2	Type B USA/6346/B	17.7" x 187.6"	7.50	15,000+	26.2	0	42,305	3,720
CNS 27-415	1	Shielded Shipping Box	39"H x 78"W x233 ¾"L	0.66-1.15	.075	415	27	26,725	No Limit

*

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Duratek

Table 3
Duratek Polyethylene HICs Dimensions and Volumes

Empty Size/Type Polyethylene HICs	Weight (Lbs.)	Height (In.)	Diameter (in.)	Internal Usable Vol. (cu ft.)	Disposal Volume
PL6-80 MT	500	56.5	57	73.3	83.4
PL6-80 MTIF	525	56.5	57	64.1	83.4
PL6-80 FR	550	56.5	57	73.3	83.4
PL6-80 FP/FEDX	625	56.5	57	73.3	83.4
PL8-120 MT	600	73.5	60	107.6	120.3
PL8-120 MTIF	625	73.5	60	95.8	120.3
PL8-120 FR	650	73.5	60	107.6	120.3
PL8-120 FP/FEDX	725	73.5	60	107.6	120.3
PL14-170 MT	800	71.5	72.5	150.3	170.8
PL14-170 MTIF	850	71.5	72.5	134.9	170.8
PL14-170 FR	850	71.5	72.5	150.3	170.8
PL14-170 FP/FEDX	1,000	71.5	72.5	150.3	170.8
PL14-195 MT	850	78	74	171.4	194.1
PL14-195 MTIF	900	78	74	154.6	194.1
PL14-195 FR	900	78	74	171.4	194.1
PL14-195 FP/FEDX	1,050	78	74	171.4	194.1
PL14-215 MT	1,200	78.375	76	189.2	205.8
PL14-215 MTIF	1,250	78.375	76	171.7	205.8
PL14-215 FR	1,250	78.375	76	189.2	205.8
PL14-215 FP/FEDX	1,400	78.375	76	189.2	205.8
PL21-300 MT	1,100	108	80	285.1	314.2
PL21-300 MTIF	1,175	108	80	262.1	314.2
PL21-300 FR	1,150	108	80	285.1	314.2
PL21-300 FP/FEDX	1,350	108	80	285.1	314.2

NRC FORM 618
(8-2000)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE		PAGES
9168	11	71-9168	USA/9168/B(U)	1	OF	3

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. ISSUED TO *(Name and Address)*

Chem-Nuclear Systems, LLC
140 Stoneridge Drive
Columbia, SC 29210

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Chem-Nuclear Systems, Inc. application dated February 26, 1990, as supplemented.

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

(1) Model No.: CNS 8-120B

(2) Description

The packaging is a carbon steel encased, lead shielded 74-inch OD by 88-inch high cask for radioactive waste materials. The cask is a right circular cylinder with a 62-inch ID by 75-inch high cavity. The walls of the cask contain a lead thickness of 3.35 inches encased in 0.75-inch thick inner steel shell and 1-1/2-inch thick outer steel shell. The exposed sides of the package are provided with a thermal barrier consisting of a 5/32-inch diameter wire wrap on 12-inch centers and covered with a 3/16-inch thick steel jacket. The bottom weldment is made of two, 3-1/4-inch thick carbon steel plates. The primary lid is sealed with a double silicone O-ring and 20 equally spaced 2-inch diameter bolts. The centered secondary lid is sealed with a double silicone O-ring and twelve equally spaced 2-inch diameter bolts, and covers a 29-inch opening in the primary lid. The optional drain line is sealed with a 3/4-inch diameter cap screw and a silicone O-ring. The lid sealing surfaces are stainless steel and the space between the double O-ring seals is provided with a test port for leak testing.

The top and bottom of the cask are provided with steel encased, rigid polyurethane foam impact limiters. The impact limiters are secured to each other about the cask with eight 1-inch diameter ratchet binders. The impact limiters are 102 inches in diameter and the overall height of the package with the impact limiters attached is 132 inches.

The package is provided with four tie-down and two removable lifting devices. Each lid is provided with three lifting lugs. The gross weight of the packaging and contents is approximately 74,000 pounds.

NRC FORM 618 (5-2000) 10 CFR 71	CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIAL PACKAGES			U.S. NUCLEAR REGULATORY COMMISSION	
1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9168	11	71-9168	USA/9168/B(U)	2 OF	3

(a) Packaging (Continued)

(3) Drawings

The packaging is constructed in accordance with Chem-Nuclear Systems, Inc. Drawing No. C-110-E-0007, Sheets 1, 2, and 3, Revision No. 10. I

(b) Contents

(1) Type and form of material

(i) Byproduct material in the form of dewatered resins, solids, or solidified waste contained within secondary containers; or

(ii) Radioactive material in the form of activated reactor components.

(2) Maximum quantity of material per package

Type B quantity of radioactive material, not to exceed 2,000 times a Type A quantity, 100 thermal watts, and 14,680 pounds including weight of the contents, secondary containers, and shoring. The contents may include fissile materials provided the mass limits of 10 CFR 71.53 are not exceeded. 15 grams

6. Except for close fitting contents, wood shoring must be placed between the secondary containers, or activated components, and the cask cavity to prevent movement during accident conditions of transport.

7. The cask primary lid must be secured by twenty and the secondary lid by twelve, 2"-8UNC-2A x 4-3/4" or twelve, 2"-8UNC-2A x 4" long hex cap screws with a flat washer torqued to 500 ft-lbs ± 50 ft-lbs (lubricated). I

8. Prior to each shipment, the package must be leak tested in accordance with Section 8.2.2.2 of the application. For contents that meet the definition of low specific activity material or surface contaminated objects in 10 CFR 71.4, and also meet the exemption standard for low specific activity material and surface contaminated objects in 10 CFR 71.10(b)(2), the pre-shipment leak test is not required.

9. In addition to the requirements of Subpart G of 10 CFR Part 71:

(i) Each package must meet the acceptance tests and be maintained in accordance with the Acceptance Tests and Maintenance Program of Section 8.0 of the application,

(ii) The seals must be replaced with new seals if inspection shows any defects or every 12 months, whichever occurs first. The tests ports and optional drain line must be appropriately plugged and sealed prior to transport, and

(iii) The package must be prepared for shipment and operated in accordance with the operating procedures of Section 7.0 of the application.

NRC FORM 618 (8-2000) 10 CFR 71	CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIAL PACKAGES		U.S. NUCLEAR REGULATORY COMMISSION		
1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9168	11	71-9168	USA/9168/B(U)	3 OF	3

10. (a) For any package containing water or organic substances which could radiolytically generate combustible gases, determination must be made by tests and measurements or by analysis of a representative package such that the following criteria are met over a period of time that is twice the expected shipment time:

(i) The hydrogen generated must be limited to a molar quantity that would be no more than 5% by volume (or equivalent limits for other inflammable gases) of the secondary container gas void if present at STP (i.e., no more than 0.063 g-moles/ft^3 at 14.7 psia and 70°F) or

(ii) The secondary container and cask cavity must be inerted with a diluent to assure that oxygen must be limited to 5% by volume in those portions of the package which could have hydrogen greater than 5%.

For any package delivered to a carrier for transport, the secondary container must be prepared for shipment in the same manner in which determination for gas generation is made. Shipment period begins when the package is prepared (sealed) and must be completed within twice the expected shipment time.

(b) For any package containing materials with a radioactivity concentration not exceeding that for low specific activity material, and shipped within 10 days of preparation, or within 10 days after venting of drums or other secondary containers, the determination in (a) above need not be made, and the time restriction in (a) above does not apply.

11. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.12.

12. Expiration date: June 30, 2005.

REFERENCES

Chem-Nuclear Systems, Inc., application dated February 26, 1990.

Supplements dated: February 22, 1994; February 23, 1995; September 1, 1998; May 25 and June 1, 1999; and May 26, August 23 and 30, December 8, 2000 and January 30, 2001.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

E. William Brach, Director
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Date: FEbruary 6, 2001

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION REPORT

Docket No. 71-9168
Model No. CNS 8-120B Package
Certificate of Compliance No. 9168
Revision No. 11

SUMMARY

By application dated December 8, 2000, as supplemented January 30, 2001, Chem-Nuclear Systems, LLC (CNS) requested an amendment to Certificate of Compliance No. 9168, for the Model No. CNS 8-120B package. CNS requested that the operating procedures specified in Chapter 7 of the Safety Analysis Report (SAR) be amended. CNS also requested that the parts list on the package drawing be revised to correct the bolt lengths for the primary and secondary lid closure bolts, and to increase the durometer tolerance for the silicone O-rings. Based on the statements and representations in the application, the staff agrees that these changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

EVALUATION

CNS requested revision to the SAR for the Model No. CNS 8-120B package in its application dated December 8, 2000. The revisions to the SAR are operating procedure changes in Chapter 7, and editorial corrections to the SAR Table of Contents. Certificate of Compliance No. 9168 has been amended to reference the December 8, 2000, application.

The operating procedure changes requested by the applicant include modifying the step for torquing the lid bolts to require they be torqued in a two-step process. Additionally, the step specifying the final torque value for the secondary lid has been modified to indicate the value as 500 ft-lbs, instead of the previous value of 250 ft-lbs, which was a typographical error.

In a supplement dated January 30, 2001, CNS requested revision to package drawing C-110-E-0007, "CNSI 8-120B Shipping Cask." The requested change would:

1) Correct the primary and secondary lid closure bolt lengths to reference bolts of 4 3/4 inch length as well as bolts of 4 inch length to properly reflect the fact that one of the casks in service uses bolts that are only 4 inch long. All SAR analyses were performed assuming a 4 inch bolt length, which is a conservative assumption for the 4 3/4 inch bolts.

2) Increase the durometer tolerance for the silicone O-rings from 70 +0/-10 to 60-75. The change was made to be more consistent with O-ring manufacturing practices and tolerances.

The Certificate of Compliance has also been revised to correct the following, which are described in detail below: a) Condition 5(a)2, b) Condition 8, and c) References.

A minor change was made to the package description in Certificate of Compliance Condition 5(a)2 to properly label the dimensions of the package. The secondary lid covers a 29-inch opening in the primary lid, but is not, itself, 29-inches in dimension. A minor revision was also made to Condition 7 of the Certificate of Compliance to reflect the correct length of the primary and secondary lid bolts, as described in Drawing No. C-110-E-0007, Sheet 3, Revision No. 9. Finally, a reference was added for the February 23, 1995, application for renewal of the Certificate of Compliance, for completeness of the References section.

The staff reviewed the changes to the operating procedures and the package drawing. The staff agrees that the changes are minor and do not affect the safety analyses in the SAR. Therefore, the staff concludes that the proposed changes are acceptable, and the changes do not impact the ability of the package to meet 10 CFR Part 71.

CONCLUSION

The Certificate of Compliance has been revised to reference the December 8, 2000, SAR changes and the January 30, 2001 package drawing changes.

Based on the review of the statements and representations in the application, the staff concludes that the package meets the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9168, Revision No. 11,
on February 6, 2001

Attachment 2

(Excel 97 Spreadsheets used to convert INEEL Data)
Data Sheets
"V-1 Tank Avg_Max_Total Calcs"
"V-2 Tank Avg_Max_Total Calcs"
"V-3 Tank Avg_Max_Total Calcs"
"V-9 Tank Avg_Max_Total Calcs"

V1 Solid Data – pC/g **Sample Profile Data For Maximum and Average DOT and 10CFR 61.55 Calc. V-1**

	(1-1) 2CB101011V	(1-2) 2CB102011V	(2-1) 2CB103011V	(2-1) 2CB103015V	(profile) 2CB109015V	Avg	
U-233/234	2.51E+03	1.76E+03	1.04E+04	7.27E+03	4.33E+03	5.254E+03	
U-235	7.83E+01	5.83E+01	3.16E+02	2.14E+02	1.30E+02	1.593E+02	
U-238	1.14E+02	6.54E+01	1.06E+02	8.06E+01	6.74E+01	8.668E+01	max values
Pu-238	2.61E+04	2.62E+04	2.37E+04	8.59E+03	1.07E+04	1.906E+04	2.62E+04
Pu-239/240	1.08E+04	1.12E+04	1.14E+04	4.60E+03	5.45E+03	8.690E+03	1.14E+04
Am-241	2.81E+04	3.28E+04	2.52E+04	9.24E+03	1.17E+04	2.141E+04	3.28E+04
Cm-242	1.10E+02	1.12E+02	9.80E+01	1.52E+01	3.91E+01	7.486E+01	1.12E+02
Cm-243/244	8.40E+03	9.63E+03	7.26E+03	2.79E+03	3.47E+03	6.310E+03	9.63E+03
Np-237	2.99E+01	2.79E+01	2.13E+01	3.94E+01	1.47E+01	2.664E+01	3.94E+01
Sr-90	4.89E+06	4.04E+06	1.43E+07	6.75E+06	8.56E+06	7.708E+06	
Ag-108m	1.88E+03	6.31E+02	1.32E+03	1.01E+03	6.91E+02	1.106E+03	
Ag-110m	3.47E+03	1.05E+03	1.95E+03	1.92E+03	1.34E+03	1.946E+03	
Am-241c	2.76E+04	3.56E+04	1.18E+04	6.78E+03	1.03E+04	1.842E+04	
Ce-144	1.84E+04	6.82E+03	2.18E+04	1.03E+04	7.19E+03	1.290E+04	
Co-58	3.70E+03	1.22E+03	4.37E+03	1.20E+03	8.25E+02	2.263E+03	
Co-60	4.46E+05	1.51E+05	3.68E+05	1.84E+05	6.70E+04	2.432E+05	
Cs-134	2.91E+03	2.16E+03	1.49E+03	5.02E+02	7.26E+02	1.558E+03	
Cs-137	7.26E+06	5.91E+06	1.58E+07	9.96E+06	5.10E+06	8.806E+06	
Eu-152	4.54E+04	5.29E+04	3.73E+04	1.52E+04	2.56E+04	3.528E+04	
Eu-154	6.43E+04	7.12E+04	5.34E+04	2.03E+04	2.82E+04	4.748E+04	
Eu-155	6.78E+03	2.70E+03	6.11E+03	3.77E+03	2.63E+03	4.398E+03	
Mn-54	1.38E+03	4.37E+02	1.51E+03	4.41E+02	2.82E+02	8.100E+02	
Nb-95	3.95E+03	1.30E+03	1.75E+04	1.28E+03	8.95E+02	4.985E+03	
Ra-226	8.49E+02	3.32E+02	1.12E+03	3.81E+02	3.36E+02	6.036E+02	
Ru-103	2.47E+04	1.02E+04	3.40E+04	1.38E+04	1.06E+04	1.866E+04	
Ru-106	2.29E+04	7.47E+03	2.42E+04	1.24E+04	8.58E+03	1.511E+04	
Sb-125	8.29E+03	3.43E+03	1.09E+04	4.68E+03	3.21E+03	6.102E+03	
U-235c	3.02E+03	1.19E+03	4.00E+03	1.63E+03	1.12E+03	2.192E+03	
Zn-65	3.64E+03	1.13E+03	3.52E+03	1.16E+03	7.30E+02	2.036E+03	
Zr-95	7.01E+03	2.33E+03	8.74E+03	2.31E+03	1.59E+03	4.396E+03	
I-129	1.42E+02	4.36E+01	6.52E+01	4.80E+01	4.14E+01	6.804E+01	
Ni-63	1.98E+06	6.70E+05	3.31E+06	1.72E+06	7.25E+05	1.681E+06	

a. Analysis performed on solid portion of samples following gravity filtration; data validation level "C."
b. U - not detected, detection limit given in parenthesis.
c. Analysis by gamma spectroscopy.

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V2 Solid Data -- pC/g **Sample Profile Data For Maximum and Average DOT and 10CFR 61.55 Calc. V-2**

	(1-2) 2CB201011V	(2-2) 2CB203011V	(2-2) 2CB203015V	(profile) 2CB208015V	Avg	
U-233/234	3.790E+03	2.660E+03	3.150E+03	3.350E+03	2.590E+03	
U-235	1.130E+02	8.100E+01	1.000E+02	1.020E+02	7.920E+01	
U-238	1.310E+02	5.130E+01	9.700E+01	7.480E+01	7.082E+01	max values
Pu-238	5.690E+03	4.440E+03	1.390E+04	7.540E+03	6.314E+03	1.390E+04
Pu-239/240	8.260E+03	7.500E+03	6.150E+03	4.730E+03	5.328E+03	8.260E+03
Am-241	3.520E+03	2.680E+03	2.500E+03	1.230E+03	1.986E+03	3.520E+03
Cm-242	3.220E+00	1.990E+00	9.460E+00	3.640E+00	3.662E+00	9.460E+00
Cm-243/244	1.610E+02	1.260E+02	1.170E+02	2.440E+02	1.296E+02	2.440E+02
Np-237	3.350E+01	9.190E+00	3.790E+01	2.380E+01	2.088E+01	3.790E+01
Sr-90	1.650E+07	1.150E+07	1.070E+07	1.610E+07	1.096E+07	
Ag-108m	2.080E+03	7.530E+02	4.510E+02	7.590E+02	8.086E+02	
Ag-110m	3.910E+03	7.940E+02	7.600E+02	1.360E+03	1.365E+03	
Ce-144	2.070E+04	4.960E+03	4.890E+03	7.470E+03	7.604E+03	
Co-58	3.730E+03	9.000E+02	8.890E+02	6.970E+02	1.243E+03	
Co-60	7.050E+05	1.560E+05	1.380E+05	7.580E+04	2.150E+05	
Cs-134	1.270E+03	3.160E+02	3.170E+02	2.900E+02	4.386E+02	
Cs-137	1.410E+07	6.330E+06	5.660E+06	4.870E+06	6.192E+06	
Eu-152	4.860E+04	2.950E+03	3.030E+03	9.930E+03	1.290E+04	
Eu-154	3.340E+04	2.440E+04	2.020E+04	1.460E+04	1.852E+04	
Eu-155	7.610E+03	2.580E+03	2.870E+03	2.930E+03	3.198E+03	
Mn-54	1.360E+03	3.350E+02	3.320E+02	2.990E+02	4.652E+02	
Nb-95	3.890E+03	9.720E+02	9.540E+02	7.280E+02	1.309E+03	
Ra-226	8.930E+03	2.410E+02	2.570E+02	3.730E+02	1.960E+03	
Ru-103	2.740E+04	6.960E+03	6.760E+03	6.980E+03	9.620E+03	
Ru-106	2.540E+04	5.440E+03	5.360E+03	8.860E+03	9.012E+03	
Sb-125	9.360E+03	2.450E+03	2.420E+03	3.440E+03	3.534E+03	
Zn-65	3.630E+03	7.750E+02	7.780E+02	7.510E+02	1.187E+03	
Zr-95	6.920E+03	1.770E+03	1.720E+03	1.280E+03	2.338E+03	
I-129	6.840E+01	1.150E+02	3.460E+01	5.770E+01	5.514E+01	
Ni-63	1.750E+06	5.570E+05	8.040E+05	5.690E+05	7.360E+05	

a. Analysis performed on solid portion of samples following gravity filtration; data validation level "C."
b. U - not detected, detection limit given in parenthesis
c. Analysis by gamma spectroscopy.

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V3 Solid Data -- pC/g **Sample Profile Data For Maximum and Average DOT and 10CFR 61.55 Calc. V-3**

	(1-1) 2CB301011V	(1-2) 2CB302011V	(2-1) 2CB303011V	(2-1) 2CB303016V	(profile) 2CB308015V	AVG	
U-233/234	1.380E+03	1.110E+03	2.430E+03	2.180E+03	4.060E+03	2.232E+03	
U-235	5.030E+01	3.800E+01	7.920E+01	6.890E+01	1.280E+02	7.288E+01	
U-238	6.480E+01	5.050E+01	7.920E+01	6.110E+01	8.500E+01	6.812E+01	max values
Pu-238	1.530E+04	1.460E+04	1.180E+04	1.420E+04	1.080E+04	1.334E+04	1.530E+04
Pu-239/240	1.000E+04	7.440E+03	5.370E+03	6.840E+03	4.810E+03	6.892E+03	1.000E+04
Am-241	1.150E+04	7.660E+03	4.840E+03	6.180E+03	5.620E+03	7.160E+03	1.150E+04
Cm-242	8.360E+01	1.990E+01	1.320E+01	7.540E+01	4.780E+01	4.798E+01	8.360E+01
Cm-243/244	3.690E+03	2.070E+03	1.140E+03	1.590E+03	1.570E+03	2.012E+03	3.690E+03
Np-237	2.380E+01	2.590E+01	2.000E+01	2.090E+01	5.750E+01	2.962E+01	5.750E+01
Sr-90	6.210E+06	1.020E+07	2.320E+07	4.450E+07	2.400E+07	2.162E+07	
Ag-108m	4.130E+02	1.010E+03	1.360E+03	1.190E+03	7.770E+02	9.500E+02	
Ag-110m	7.110E+02	1.910E+03	2.610E+03	2.240E+03	1.030E+03	1.700E+03	
Ce-144	4.550E+03	1.030E+04	1.450E+04	1.250E+04	2.560E+04	1.349E+04	
Co-58	8.240E+02	1.760E+03	1.620E+03	1.860E+03	2.350E+03	1.683E+03	
Co-60	1.840E+05	3.210E+05	1.280E+05	2.230E+05	8.050E+04	1.873E+05	
Cs-134	2.640E+03	2.370E+03	5.810E+02	8.970E+02	1.090E+03	1.516E+03	
Cs-137	6.810E+06	7.450E+06	8.050E+06	6.630E+06	9.050E+06	7.598E+06	
Eu-152	2.840E+04	2.930E+04	8.470E+03	1.280E+04	1.250E+04	1.829E+04	
Eu-154	3.790E+04	3.380E+04	2.630E+04	3.060E+04	2.850E+04	3.142E+04	
Eu-155	2.320E+03	3.860E+03	5.420E+03	4.720E+03	5.190E+03	4.302E+03	
Mn-54	2.940E+02	6.350E+02	5.720E+02	6.780E+02	8.150E+02	5.988E+02	
Nb-95	8.830E+02	1.870E+03	1.770E+03	1.960E+03	9.480E+03	3.193E+03	
Ra-226	2.200E+02	4.500E+02	5.230E+02	5.120E+03	8.260E+03	2.915E+03	
Ru-103	6.900E+03	1.370E+04	1.930E+04	1.630E+04	2.530E+04	1.630E+04	
Ru-106	4.940E+03	1.240E+04	1.680E+04	1.450E+04	1.790E+04	1.331E+04	
Sb-125	2.260E+03	4.560E+03	6.300E+03	5.390E+03	8.300E+03	5.362E+03	
Zn-65	7.310E+02	1.690E+03	1.460E+03	1.760E+03	1.790E+03	1.486E+03	
Zr-95	1.570E+03	3.290E+03	3.140E+03	3.560E+03	6.850E+03	3.682E+03	
I-129	7.820E+01	4.830E+01	6.910E+01	1.080E+02	4.800E+01	7.032E+01	
Ni-63	1.770E+06	1.480E+06	9.690E+05	1.110E+05	4.410E+05	9.542E+05	

a. Analysis performed on solid portion of samples following gravity filtration; data validation level "C."
b. U - not detected, detection limit given in parenthesis.
c. Analysis by gamma spectroscopy.

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V1-V3 Liquid Data -- pC/L **Liquid Sample Profile Tanks V-1,V-2 and V-3 DOT and 10CFR 61.55 Calc.**

	(V-1) 2CB109015V	(V-2) 2CB208015V	(V-3) 2CB308015V	(V-3)[1 note] 2CB307018V
U-233/234	1.890E+04	3.860E+04	1.330E+04	
U-235	5.660E+02	1.600E+03	4.010E+02	
U-238	2.100E+02	4.990E+02	1.350E+02	
Pu-238	2.240E+02	4.750E+02	3.830E+01	
Pu-239/240	1.050E+02	2.830E+02	1.970E+01	
Am-241	1.970E+02	5.890E+01	3.180E+01	
Cm-242	8.610E+00	4.960E+00	6.180E+00	
Cm-243/244	6.420E+01	1.620E+01	6.280E+00	
Np-237	2.670E+01	2.760E+01	3.640E+01	
Sr-90	2.030E+06	4.900E+06	1.230E+07	
Ag-108m	7.760E+02	3.960E+03	8.900E+02	3.430E+02
Ag-110m	1.270E+03	7.120E+03	1.450E+03	9.060E+02
Ce-144	7.530E+03	3.780E+04	9.100E+03	3.000E+03
Co-58	2.160E+03	1.600E+03	2.060E+03	2.840E+02
Co-60	1.550E+04	1.300E+04	1.480E+04	4.480E+03
Cs-134	7.340E+02	7.640E+02	7.260E+02	4.490E+02
Cs-137	2.900E+06	1.350E+07	4.230E+06	1.560E+06
Eu-152	4.860E+03	4.760E+03	4.630E+03	6.930E+02
Eu-154	1.660E+03	1.820E+03	1.530E+03	2.130E+02
Eu-155	2.420E+03	1.440E+04	3.020E+03	1.170E+03
Mn-54	7.550E+02	7.160E+02	7.480E+02	1.060E+02
Nb-95	2.400E+03	1.960E+03	2.220E+03	3.190E+02
Ra-226	1.260E+03	4.100E+03	1.220E+03	3.320E+02
Ru-103	1.290E+04	3.600E+04	1.360E+04	5.640E+03
Ru-106	9.430E+03	4.620E+04	1.050E+04	4.080E+03
Sb-125	3.870E+03	1.840E+04	4.600E+03	1.900E+03
Zn-65	1.730E+03	1.700E+03	1.640E+03	2.370E+02
Zr-95	4.300E+03	3.210E+03	4.000E+03	5.490E+02
I-129	2.520E+02	1.690E+02	2.180E+02	1.080E+02
Ni-63	2.880E+05	4.480E+05	2.050E+05	
H-3	3.040E+07	1.020E+08	6.090E+06	

Note 1 The Liquid Sample data 2CB307018V is incomplete and not factored into average calculations

V-9 Solid and Liquid Data **Liquid and Solid Sample Profile Data for DOT and 10 CFR 61.55 CALC. V-9**

Analyte	Activity (pCi/L or pCi/g) by Sample ID (matrix in parenthesis)			
	2CB90201 (liquid)	2CB90310 (sludge)	2CB90302 (sludge)	
U-233	1.240E+04	9.440E+02	3.420E+03	
U-234	2.110E+05	7.080E+03	1.310E+04	
U-235	6.900E+03	2.550E+02	4.500E+02	
U-236	3.260E+03	6.000E+01	1.270E+02	
U-238	9.720E+02	7.820E+01	8.250E+01	max solid values
Pu-238	1.700E+05	1.150E+04	2.860E+04	2.860E+04
Pu-239	4.530E+04	7.380E+03	7.180E+03	7.380E+03
Am-241	4.020E+04	4.300E+03	5.700E+03	5.700E+03
Cm-244	5.210E+03	4.530E+02	7.040E+02	7.040E+02
Np-237	2.000E+02	2.720E+01	3.330E+01	3.330E+01
Sr-90	2.500E+08	5.740E+06	7.070E+06	
Co-60	1.180E+03	1.160E+06	7.260E+05	
Cs-137	4.200E+05	4.810E+06	6.370E+06	
Eu-152	5.660E+02			
Eu-154	2.720E+02	2.220E+04		
H-3	3.530E+08			

The purpose of this spreadsheet is to: 1) determine the average and maximum total activity for each radionuclide contaminant of Tank V-1's solid phase; and then, 2)Convert Tank V-1's activities from pCi/g or pCi/L to Ci. Note that the solid phase for V-1 utilizes 5 sample sets but only one sample set is used for the liquid phase.

Source of Data: Comprehensive remedial Investigation/Feasiblity Study (RI/FS) for Test Area North Operable Unit1-10 at INEEEL, DOE/ID-10557

Constants

1gal	=	3.785E+03 cc
1pCi	=	1.000E-12 Ci
1gal	=	3.785E+00 L

Conversion Formula:

solid pCi/g -> Ci: (pCi/g)x(1Ci/1E12pCi)x(density[g/cc])x(#gallons)x(1cc/0.000264172gal)

liquid pCi/L -> Ci: (pCi/L)x(1Ci/1E12pCi)x(#gallons)x(1L/0.2641721 gallons)

Volume Input (gal)

	Solids	Liquids	Total
V1	520	1164	1684
V2	520	1076	1596
V3	652	5818 note 1	6470
V9	250	70	320

Note 1: The gallons of liquid indicated in tank V-3 was the quantity at the time of sample. This number represents a more conservative concentration than if the current 7648 gallons were use

Note: Shaded radionuclides below indicate that detection limits were used if the measurement result was less than the detection limit to be conservative.

	V-1 Tank Solids		V-1 Tank Solids		V-1 Tank Liquids		V-1 Tank Totals (Ci)		43.1% of total activity	3.21% of total activity)	0.89% of total activity)	0.44537% of total activity
	Average (pCi/g)	Average (Ci)	Max (pCi/g)	Max (Ci)	Activity (pCi/L)	Activity (Ci)	Avg+ Liq	Max+Liq	Activity/HIC (725 gal) Avg	Activity/HIC (56 gal) Avg	Activity/HIC (15 gal) Avg	Activity/HIC (7.5 gal) Avg
U-233	5.254E+03	1.055E-02	1.040E+04	2.088E-02	1.890E+04	8.328E-05	1.063E-02	2.096E-02	4.582E-03	3.409E-04	9.470E-05	4.735E-05
U-235	1.593E+02	3.199E-04	3.160E+02	6.345E-04	5.660E+02	2.494E-06	3.224E-04	6.370E-04	1.389E-04	1.034E-05	2.871E-06	1.436E-06
U-238	8.668E+01	1.740E-04	1.140E+02	2.289E-04	2.100E+02	9.253E-07	1.750E-04	2.298E-04	7.541E-05	5.610E-06	1.558E-06	7.792E-07
Pu-238	1.906E+04	3.826E-02	2.620E+04	5.260E-02	2.240E+02	9.870E-07	3.827E-02	5.260E-02	1.649E-02	1.227E-03	3.408E-04	1.704E-04
Pu-239	8.690E+03	1.745E-02	1.140E+04	2.289E-02	1.050E+02	4.627E-07	1.745E-02	2.289E-02	7.520E-03	5.595E-04	1.554E-04	7.771E-05
Am-241	2.141E+04	4.298E-02	3.280E+04	6.586E-02	1.970E+02	8.680E-07	4.298E-02	6.586E-02	1.853E-02	1.378E-03	3.829E-04	1.914E-04
Cm-242	7.486E+01	1.503E-04	1.120E+02	2.249E-04	8.610E+00	3.794E-08	1.503E-04	2.249E-04	6.480E-05	4.821E-06	1.339E-06	6.696E-07
Cm-244	6.310E+03	1.267E-02	9.630E+03	1.933E-02	6.420E+01	2.829E-07	1.267E-02	1.934E-02	5.460E-03	4.063E-04	1.128E-04	5.643E-05
Np-237	2.664E+01	5.349E-05	3.940E+01	7.911E-05	2.670E+01	1.176E-07	5.360E-05	7.922E-05	2.310E-05	1.719E-06	4.775E-07	2.387E-07
Sr-90	7.708E+06	1.548E+01	1.430E+07	2.871E+01	2.030E+06	8.945E-03	1.548E+01	2.872E+01	6.674E+00	4.966E-01	1.379E-01	6.897E-02
Ag-108m	1.106E+03	2.221E-03	1.880E+03	3.775E-03	7.760E+02	3.419E-06	2.225E-03	3.778E-03	9.589E-04	7.134E-05	1.982E-05	9.909E-06
Ag-110m	1.946E+03	3.907E-03	3.470E+03	6.967E-03	1.270E+03	5.596E-06	3.913E-03	6.973E-03	1.686E-03	1.255E-04	3.485E-05	1.743E-05
Ce-144	1.290E+04	2.590E-02	2.180E+04	4.377E-02	7.530E+03	3.318E-05	2.594E-02	4.380E-02	1.118E-02	8.317E-04	2.310E-04	1.155E-04
Co-58	2.263E+03	4.544E-03	4.370E+03	8.774E-03	2.160E+03	9.517E-06	4.553E-03	8.783E-03	1.962E-03	1.460E-04	4.055E-05	2.028E-05
Co-60	2.432E+05	4.883E-01	4.460E+05	8.955E-01	1.550E+04	6.830E-05	4.884E-01	8.955E-01	2.105E-01	1.566E-02	4.350E-03	2.175E-03
Cs-134	1.558E+03	3.127E-03	2.910E+03	5.843E-03	7.340E+02	3.234E-06	3.131E-03	5.846E-03	1.349E-03	1.004E-04	2.788E-05	1.394E-05
Cs-137	8.806E+06	1.768E+01	1.580E+07	3.172E+01	2.900E+06	1.278E-02	1.769E+01	3.174E+01	7.626E+00	5.674E-01	1.576E-01	7.880E-02
Eu-152	3.528E+04	7.083E-02	5.290E+04	1.062E-01	4.860E+03	2.141E-05	7.086E-02	1.062E-01	3.054E-02	2.272E-03	6.311E-04	3.156E-04
Eu-154	4.748E+04	9.533E-02	7.120E+04	1.430E-01	1.660E+03	7.314E-06	9.534E-02	1.430E-01	4.109E-02	3.057E-03	8.492E-04	4.246E-04
Eu-155	4.398E+03	8.830E-03	6.780E+03	1.361E-02	2.420E+03	1.066E-05	8.841E-03	1.362E-02	3.810E-03	2.835E-04	7.875E-05	3.937E-05
Mn-54	8.100E+02	1.626E-03	1.510E+03	3.032E-03	7.550E+02	3.327E-06	1.630E-03	3.035E-03	7.024E-04	5.226E-05	1.452E-05	7.258E-06
Nb-95	4.985E+03	1.001E-02	1.750E+04	3.514E-02	2.400E+03	1.057E-05	1.002E-02	3.515E-02	4.318E-03	3.213E-04	8.924E-05	4.462E-05
Ra-226	6.036E+02	1.212E-03	1.120E+03	2.249E-03	1.260E+03	5.552E-06	1.217E-03	2.254E-03	5.247E-04	3.904E-05	1.084E-05	5.422E-06
Ru-103	1.866E+04	3.747E-02	3.400E+04	6.826E-02	1.290E+04	5.684E-05	3.752E-02	6.832E-02	1.617E-02	1.203E-03	3.342E-04	1.671E-04
Ru-106	1.511E+04	3.034E-02	2.420E+04	4.859E-02	9.430E+03	4.155E-05	3.038E-02	4.863E-02	1.309E-02	9.742E-04	2.706E-04	1.353E-04
Sb-125	6.102E+03	1.225E-02	1.090E+04	2.188E-02	3.870E+03	1.705E-05	1.227E-02	2.190E-02	5.288E-03	3.934E-04	1.093E-04	5.464E-05
Zn-65	2.036E+03	4.088E-03	3.640E+03	7.308E-03	1.730E+03	7.623E-06	4.095E-03	7.316E-03	1.765E-03	1.313E-04	3.648E-05	1.824E-05
Zr-95	4.396E+03	8.826E-03	8.740E+03	1.755E-02	4.300E+03	1.895E-05	8.845E-03	1.757E-02	3.812E-03	2.836E-04	7.878E-05	3.939E-05
I-129	6.804E+01	1.366E-04	1.420E+02	2.851E-04	2.520E+02	1.110E-06	1.377E-04	2.862E-04	5.936E-05	4.416E-06	1.227E-06	6.134E-07
Ni-63	1.681E+06	3.375E+00	3.310E+06	6.646E+00	2.880E+05	1.269E-03	3.376E+00	6.647E+00	1.455E+00	1.083E-01	3.007E-02	1.504E-02
H-3					3.040E+07	1.339E-01	1.339E-01	1.339E-01	5.773E-02	4.295E-03	1.193E-03	5.966E-04
The following daughter (decay) products are in secular equilibrium with the parent radionuclide and should be included for DOT determinations:												
Th-234							1.750E-04	2.298E-04	7.541E-05	5.610E-06	1.558E-06	7.792E-07
Pa-233							5.360E-05	7.922E-05	2.310E-05	1.719E-06	4.775E-07	2.387E-07
Add Pu-241 at 9.52 times the activity of Am-241per 49 CFR 173.433 requirements.												
Pu-241							4.092E-01	6.269E-01	1.764E-01	1.312E-02	3.645E-03	1.822E-03

The purpose of this spreadsheet is to: 1) determinethe average and maximum total activity for each radionuclide contaminant of Tank V-2's solid phase; and then, 2)Convert Tank V-2's activities from pCi/g or pCi/L to Ci. Note that the solid phase for V-2 utilizes 4 sample sets but only one sample set is used for the liquid phase.

Source of Data: Comprehensive remedial Investigation/Feasiblity Study (RI/FS) for Test Area North Operable Unit1-10 at INEEEL, DOE/ID-10557

Constants

1gal	=	3.785E+03 cc
1pCi	=	1.000E-12 Ci
1gal	=	3.785E+00 L

Conversion Formula:

solid pCi/g -> Ci: (pCi/g)x(1Ci/1E12pCi)x(density[g/cc])x(#gallons)x(1cc/0.000264172gal)

liquid pCi/L -> Ci: (pCi/L)x(1Ci/1E12pCi)x(#gallons)x(1L/0.2641721 gallons)

Volume Input (gal)

	Solids	Liquids	Total
V1	520	1164	1684
V2	520	1076	1596
V3	652	5818 [note 1]	6470
V9	250	70	320

Note 1: The gallons of liquid indicated in tank V-3 was the quantity at the time of sample. This number represents a more conservative concentration than if the current 7648 gallons were used.

Note: Shaded radionuclides below indicate that detection limits were used if the measurement result was less than the detection limit to be conservative.

0.25063% of total activity

	V-2 Tank Solids		V-2 Tank Solids		V-2 Tank Liquids		V-2 Tank Totals (Ci)		Activity/HIC (4 gal)
	Average (pCi/g)	Average (Ci)	Max (pCi/g)	Max (Ci)	Activity (pCi/L)	Activity (Ci)	Avg+ Liq	Max+Liq	Avg
U-233	3.238E+03	6.500E-03	3.790E+03	7.609E-03	3.860E+04	1.572E-04	6.657E-03	7.767E-03	1.669E-05
U-235	9.900E+01	1.988E-04	1.130E+02	2.269E-04	1.600E+03	6.517E-06	2.053E-04	2.334E-04	5.145E-07
U-238	8.853E+01	1.777E-04	1.310E+02	2.630E-04	4.990E+02	2.032E-06	1.798E-04	2.651E-04	4.506E-07
Pu-238	7.893E+03	1.585E-02	1.390E+04	2.791E-02	4.750E+02	1.935E-06	1.585E-02	2.791E-02	3.972E-05
Pu-239	6.660E+03	1.337E-02	8.260E+03	1.658E-02	2.830E+02	1.153E-06	1.337E-02	1.659E-02	3.352E-05
Am-241	2.483E+03	4.984E-03	3.520E+03	7.067E-03	5.890E+01	2.399E-07	4.985E-03	7.068E-03	1.249E-05
Cm-242	4.578E+00	9.191E-06	9.460E+00	1.899E-05	4.960E+00	2.020E-08	9.211E-06	1.901E-05	2.309E-08
Cm-243	1.620E+02	3.253E-04	2.440E+02	4.899E-04	1.620E+01	6.598E-08	3.253E-04	4.900E-04	8.154E-07
Np-237	2.610E+01	5.240E-05	3.790E+01	7.609E-05	2.760E+01	1.124E-07	5.251E-05	7.621E-05	1.316E-07
Sr-90	1.370E+07	2.751E+01	1.650E+07	3.313E+01	4.900E+06	1.996E-02	2.753E+01	3.315E+01	6.899E-02
Ag-108m	1.011E+03	2.029E-03	2.080E+03	4.176E-03	3.960E+03	1.613E-05	2.045E-03	4.192E-03	5.127E-06
Ag-110m	1.706E+03	3.425E-03	3.910E+03	7.850E-03	7.120E+03	2.900E-05	3.454E-03	7.879E-03	8.657E-06
Ce-144	9.505E+03	1.908E-02	2.070E+04	4.156E-02	3.780E+04	1.540E-04	1.924E-02	4.171E-02	4.822E-05
Co-58	1.554E+03	3.120E-03	3.730E+03	7.489E-03	1.600E+03	6.517E-06	3.127E-03	7.496E-03	7.836E-06
Co-60	2.687E+05	5.395E-01	7.050E+05	1.415E+00	1.300E+04	5.295E-05	5.395E-01	1.416E+00	1.352E-03
Cs-134	5.483E+02	1.101E-03	1.270E+03	2.550E-03	7.640E+02	3.112E-06	1.104E-03	2.553E-03	2.767E-06
Cs-137	7.740E+06	1.554E+01	1.410E+07	2.831E+01	1.350E+07	5.499E-02	1.560E+01	2.836E+01	3.909E-02
Eu-152	1.613E+04	3.238E-02	4.860E+04	9.758E-02	4.760E+03	1.939E-05	3.240E-02	9.760E-02	8.120E-05
Eu-154	2.315E+04	4.648E-02	3.340E+04	6.706E-02	1.820E+03	7.413E-06	4.649E-02	6.707E-02	1.165E-04
Eu-155	3.998E+03	8.026E-03	7.610E+03	1.528E-02	1.440E+04	5.865E-05	8.085E-03	1.534E-02	2.026E-05
Mn-54	5.815E+02	1.168E-03	1.360E+03	2.731E-03	7.160E+02	2.916E-06	1.170E-03	2.733E-03	2.933E-06
Nb-95	1.636E+03	3.285E-03	3.890E+03	7.810E-03	1.960E+03	7.983E-06	3.293E-03	7.818E-03	8.253E-06
Ra-226	2.450E+03	4.920E-03	8.930E+03	1.793E-02	4.100E+03	1.670E-05	4.936E-03	1.795E-02	1.237E-05
Ru-103	1.203E+04	2.414E-02	2.740E+04	5.501E-02	3.600E+04	1.466E-04	2.429E-02	5.516E-02	6.088E-05
Ru-106	1.127E+04	2.262E-02	2.540E+04	5.100E-02	4.620E+04	1.882E-04	2.281E-02	5.119E-02	5.716E-05
Sb-125	4.418E+03	8.869E-03	9.360E+03	1.879E-02	1.840E+04	7.495E-05	8.944E-03	1.887E-02	2.242E-05
Zn-65	1.484E+03	2.979E-03	3.630E+03	7.288E-03	1.700E+03	6.924E-06	2.985E-03	7.295E-03	7.482E-06
Zr-95	2.923E+03	5.868E-03	6.920E+03	1.389E-02	3.210E+03	1.307E-05	5.881E-03	1.391E-02	1.474E-05
I-129	6.893E+01	1.384E-04	1.150E+02	2.309E-04	1.690E+02	6.884E-07	1.391E-04	2.316E-04	3.486E-07
Ni-63	9.200E+05	1.847E+00	1.750E+06	3.514E+00	4.480E+05	1.825E-03	1.849E+00	3.515E+00	4.634E-03
H-3					1.020E+08	4.155E-01	4.155E-01	4.155E-01	1.041E-03
The following daughter (decay) products are in secular equilibrium with the parent radionuclide and should be included for DOT determinations:									
Th-234							1.798E-04	2.651E-04	4.506E-07
Pa-233							5.725E-05	7.621E-05	1.435E-07
Add Pu-241 at 9.52 times the activity of Am-241per 49 CFR 173.433 requirements.									
Pu-241							4.745E-02	6.728E-02	1.189E-04

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The purpose of this spreadsheet is to: 1) determine the average and maximum total activity for each radionuclide contaminant of Tank V-3's solid phase; and then, 2)Convert Tank V-3's activities from pCi/g or pCi/L to Ci. Note that the solid phase for V-3 utilizes 5 sample sets but only one sample set is used for the liquid phase.

Source of Data: Comprehensive remedial Investigation/Feasiblity Study (RI/FS) for Test Area North Operable Unit1-10 at INEEEL, DOE/ID-10557

Constants

1gal	=	3.785E+03 cc
1pCi	=	1.000E-12 Ci
1gal	=	3.785E+00 L

Conversion Formula:

solid pCi/g -> Ci: (pCi/g)x(1Ci/1E12pCi)x(density[g/cc])x(#gallons)x(1cc/0.000264172gal)

liquid pCi/L -> Ci: (pCi/L)x(1Ci/1E12pCi)x(#gallons)x(1L/0.2641721 gallons)

Volume Input (gal)

	Solids	Liquids	Total
V1	520	1164	1684
V2	520	1076	1596
V3	652	5818 [note 1]	6470
V9	250	70	320

Note 1: The gallons of liquid indicated in tank V-3 was the quantity at the time of sample. This number represents a more conservative concentration than if the current 7648 gallons were used.

Note: Shaded radionuclides below indicate that detection limits were used if the measurement result was less than the detection limit to be conservative.

V-3 Tank Liquids fraction does not contain data factoring in results from sample # 2CB307018V

	V-3 Tank Solids		V-3 Tank Solids		V-3 Tank Liquids		V-3 Tank Totals (Ci)		0.13138% of total activity	0.1391% of total activity
	Average (pCi/g)	Average (Ci)	Max (pCi/g)	Max (Ci)	Activity (pCi/L)	Activity (Ci)	Avg+ Liq	Max+Liq	Activity/HIC (8.5 gal) Avg	Activity/HIC (9 gal) Avg
U-233	2.232E+03	5.619E-03	4.060E+03	1.022E-02	1.330E+04	2.608E-04	5.880E-03	1.048E-02	7.725E-06	8.179E-06
U-235	7.288E+01	1.835E-04	1.280E+02	3.222E-04	4.010E+02	7.865E-06	1.913E-04	3.301E-04	2.514E-07	2.661E-07
U-238	6.812E+01	1.715E-04	8.500E+01	2.140E-04	1.350E+02	2.648E-06	1.741E-04	2.166E-04	2.288E-07	2.422E-07
Pu-238	1.334E+04	3.358E-02	1.530E+04	3.852E-02	3.830E+01	7.511E-07	3.358E-02	3.852E-02	4.412E-05	4.671E-05
Pu-239	6.892E+03	1.735E-02	1.000E+04	2.517E-02	1.970E+01	3.864E-07	1.735E-02	2.517E-02	2.280E-05	2.413E-05
Am-241	7.160E+03	1.802E-02	1.150E+04	2.895E-02	3.180E+01	6.237E-07	1.803E-02	2.895E-02	2.368E-05	2.507E-05
Cm-242	4.798E+01	1.208E-04	8.360E+01	2.105E-04	6.180E+00	1.212E-07	1.209E-04	2.106E-04	1.588E-07	1.682E-07
Cm-243	2.012E+03	5.065E-03	3.690E+03	9.289E-03	6.280E+00	1.232E-07	5.065E-03	9.289E-03	6.655E-06	7.046E-06
Np-237	2.962E+01	7.457E-05	5.750E+01	1.448E-04	3.640E+01	7.139E-07	7.528E-05	1.455E-04	9.890E-08	1.047E-07
Sr-90	2.162E+07	5.443E+01	4.450E+07	1.120E+02	1.230E+07	2.412E-01	5.467E+01	1.123E+02	7.183E-02	7.605E-02
Ag-108m	9.500E+02	2.392E-03	1.360E+03	3.424E-03	8.900E+02	1.745E-05	2.409E-03	3.441E-03	3.165E-06	3.351E-06
Ag-110m	1.700E+03	4.280E-03	2.610E+03	6.571E-03	1.450E+03	2.844E-05	4.309E-03	6.599E-03	5.661E-06	5.993E-06
Ce-144	1.349E+04	3.396E-02	2.560E+04	6.445E-02	9.100E+03	1.785E-04	3.414E-02	6.462E-02	4.485E-05	4.749E-05
Co-58	1.683E+03	4.236E-03	2.350E+03	5.916E-03	2.060E+03	4.040E-05	4.277E-03	5.956E-03	5.619E-06	5.949E-06
Co-60	1.873E+05	4.715E-01	3.210E+05	8.081E-01	1.480E+04	2.903E-04	4.718E-01	8.084E-01	6.199E-04	6.563E-04
Cs-134	1.516E+03	3.815E-03	2.640E+03	6.646E-03	7.260E+02	1.424E-05	3.830E-03	6.660E-03	5.031E-06	5.327E-06
Cs-137	7.598E+06	1.913E+01	9.050E+06	2.278E+01	4.230E+06	8.296E-02	1.921E+01	2.287E+01	2.524E-02	2.672E-02
Eu-152	1.829E+04	4.605E-02	2.930E+04	7.376E-02	4.630E+03	9.080E-05	4.614E-02	7.385E-02	6.063E-05	6.419E-05
Eu-154	3.142E+04	7.910E-02	3.790E+04	9.541E-02	1.530E+03	3.001E-05	7.913E-02	9.544E-02	1.040E-04	1.101E-04
Eu-155	4.302E+03	1.083E-02	5.420E+03	1.364E-02	3.020E+03	5.923E-05	1.089E-02	1.370E-02	1.431E-05	1.515E-05
Mn-54	5.988E+02	1.507E-03	8.150E+02	2.052E-03	7.480E+02	1.467E-05	1.522E-03	2.066E-03	2.000E-06	2.117E-06
Nb-95	3.193E+03	8.037E-03	9.480E+03	2.387E-02	2.220E+03	4.354E-05	8.081E-03	2.391E-02	1.062E-05	1.124E-05
Ra-226	2.915E+03	7.337E-03	8.260E+03	2.079E-02	1.220E+03	2.393E-05	7.361E-03	2.082E-02	9.671E-06	1.024E-05
Ru-103	1.630E+04	4.103E-02	2.530E+04	6.369E-02	1.360E+04	2.667E-04	4.130E-02	6.396E-02	5.426E-05	5.745E-05
Ru-106	1.331E+04	3.350E-02	1.790E+04	4.506E-02	1.050E+04	2.059E-04	3.371E-02	4.527E-02	4.429E-05	4.689E-05
Sb-125	5.362E+03	1.350E-02	8.300E+03	2.089E-02	4.600E+03	9.022E-05	1.359E-02	2.098E-02	1.785E-05	1.890E-05
Zn-65	1.486E+03	3.741E-03	1.790E+03	4.506E-03	1.640E+03	3.216E-05	3.774E-03	4.538E-03	4.958E-06	5.249E-06
Zr-95	3.682E+03	9.269E-03	6.850E+03	1.724E-02	4.000E+03	7.845E-05	9.348E-03	1.732E-02	1.228E-05	1.300E-05
I-129	7.032E+01	1.770E-04	1.080E+02	2.719E-04	2.180E+02	4.275E-06	1.813E-04	2.762E-04	2.382E-07	2.522E-07
Ni-63	9.542E+05	2.402E+00	1.770E+06	4.456E+00	2.050E+05	4.021E-03	2.406E+00	4.460E+00	3.161E-03	3.347E-03
H-3					6.090E+06	1.194E-01	1.194E-01	1.194E-01	1.569E-04	1.661E-04
The following daughter (decay) products are in secular equilibrium with the parent radionuclide and should be included for DOT determinations:										
Th-234							1.745E-04	2.170E-04	2.292E-07	2.427E-07
Pa-233							7.537E-05	1.456E-04	9.902E-08	1.048E-07
Add Pu-241 at 9.52 times the activity of Am-241per 49 CFR 173.433 requirements.										
Pu-241							1.716E-01	2.756E-01	2.255E-04	2.387E-04

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The purpose of this spreadsheet is to: 1) determine the average and maximum total activity for each radionuclide contaminant of Tank V-9's solid phase; and then, 2)Convert Tank V-9's activities from pCi/g or pCi/L to Ci. Note that the solid phase for V-9 utilizes 2 sample sets but only one sample set is used for the liquid phase.

Source of Data: Comprehensive remedial Investigation/Feasiblity Stucy (RI/FS) for Test Area North Operable Unit1-10 at INEEEL, DOE/ID-10557

Constants

1gal	=	3.785E+03 cc
1pCi	=	1.000E-12 Ci
1gal	=	3.785E+00 L

Conversion Formula:

solid pCi/g -> Ci: (pCi/g)x(1Ci/1E12pCi)x(density[g/cc])x(#gallons)x(1cc/0.000264172gal)

liquid pCi/L -> Ci: (pCi/L)x(1Ci/1E12pCi)x(#gallons)x(1L/0.2641721 gallons)

Volume Input (gal)

	Solids	Liquids	Total
V1	520	1164	1684
V2	520	1076	1596
V3	652	5818 note 1	6470
V9	250	70	320

Note 1: The gallons of liquid indicated in tank V-3 was the quantity at the time of sample. This number represents a more conservative concentration than if the current 7648 gallons were used.

Note: Shaded radionuclides below indicate that detection limits were used if the measurement result was less than the detection limit to be conservative.

V-3 Tank Liquids fraction does not contain data factoring in results from sample # 2CB307018V

	V-9 Tank Solids		V-9 Tank Solids		V-9 Tank Liquids		V-9 Tank Totals (Ci)		1.0938% of total activity Activity/HIC (3.5 gal)
	Average (pCi/g)	Average (Ci)	Max (pCi/g)	Max (Ci)	Activity (pCi/L)	Activity (Ci)	Avg+ Liq	Max+Liq	Avg
U-233	2.182E+03	2.106E-03	3.420E+03	3.301E-03	1.240E+04	3.286E-06	2.110E-03	3.305E-03	2.307E-05
U-234	1.009E+04	9.740E-03	1.310E+04	1.265E-02	2.110E+05	5.591E-05	9.796E-03	1.270E-02	1.071E-04
U-235	3.525E+02	3.403E-04	4.500E+02	4.344E-04	6.900E+03	1.828E-06	3.421E-04	4.362E-04	3.742E-06
U-236	9.350E+01	9.025E-05	1.270E+02	1.226E-04	3.260E+03	8.638E-07	9.112E-05	1.235E-04	9.966E-07
U-238	8.035E+01	7.756E-05	8.250E+01	7.964E-05	9.720E+02	2.576E-07	7.782E-05	7.989E-05	8.512E-07
Pu-238	2.005E+04	1.935E-02	2.860E+04	2.761E-02	1.700E+05	4.505E-05	1.940E-02	2.765E-02	2.122E-04
Pu-239	7.280E+03	7.027E-03	7.380E+03	7.124E-03	4.530E+04	1.200E-05	7.039E-03	7.136E-03	7.699E-05
Am-241	5.000E+03	4.826E-03	5.700E+03	5.502E-03	4.020E+04	1.065E-05	4.837E-03	5.513E-03	5.291E-05
Cm-244	5.785E+02	5.584E-04	7.040E+02	6.796E-04	5.210E+03	1.381E-06	5.598E-04	6.809E-04	6.123E-06
Np-237	3.025E+01	2.920E-05	3.330E+01	3.214E-05	2.000E+02	5.300E-08	2.925E-05	3.220E-05	3.200E-07
Sr-90	6.405E+06	6.183E+00	7.070E+06	6.825E+00	2.500E+08	6.624E-02	6.249E+00	6.891E+00	6.835E-02
Co-60	9.430E+05	9.103E-01	1.160E+06	1.120E+00	1.180E+03	3.127E-07	9.103E-01	1.120E+00	9.956E-03
Cs-137	5.590E+06	5.396E+00	6.370E+06	6.149E+00	4.200E+05	1.113E-04	5.396E+00	6.149E+00	5.902E-02
Eu-152					5.660E+02	1.500E-07	1.500E-07	1.500E-07	1.640E-09
Eu-154	2.220E+04	2.143E-02	2.220E+04	2.143E-02	2.720E+02	7.207E-08	2.143E-02	2.143E-02	2.344E-04
H-3					3.530E+08	9.354E-02	9.354E-02	9.354E-02	1.023E-03
The following daughter (decay) products are in secular equilibrium with the parent radionuclide and should be included for DOT determinations:									
Th-234							7.782E-05	7.989E-05	8.512E-07
Pa-233							2.925E-05	3.220E-05	3.200E-07
Add Pu-241 at 9.52 times the activity of Am-241per 49 CFR 173.433 requirements.									
Pu-241							4.605E-02	5.248E-02	5.037E-04

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